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AB

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(54) An automatic sealing method

(57) In an automatic sealing method in which a continuous tubular film traveling at a substantially constant speed is sealed at predetermined pitch in a transverse direction of the travel by a sealing unit (4) disposed across the path of the tubular film (5), the sealing unit (4) is moved at substantially the same speed as the tubular film (5) during at least a period in which the sealing unit (4) is in contact with the tubular film (5). Under control of unit (21), motor (18) drives drawing-out roller (9) at substantially constant speed while the speed of second motor (20) driving the sealing unit (4) is varied.

FIG. 2

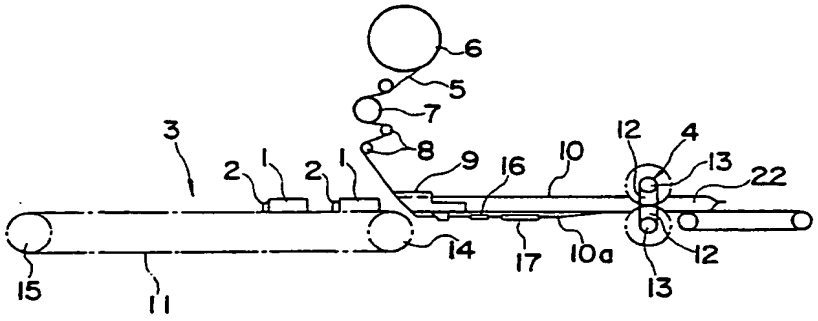

FIG. 3

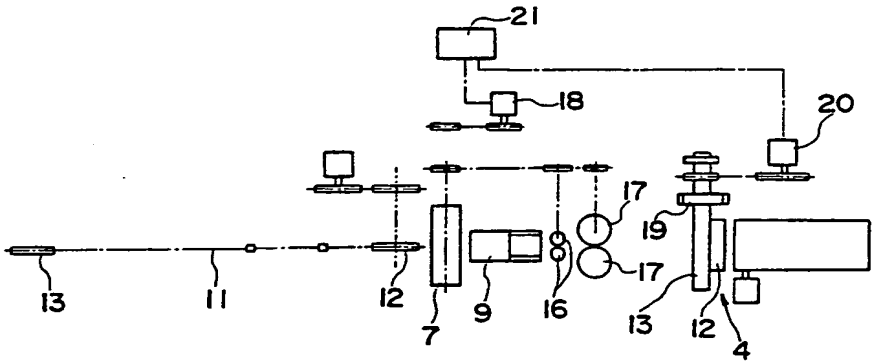

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FIG. 1

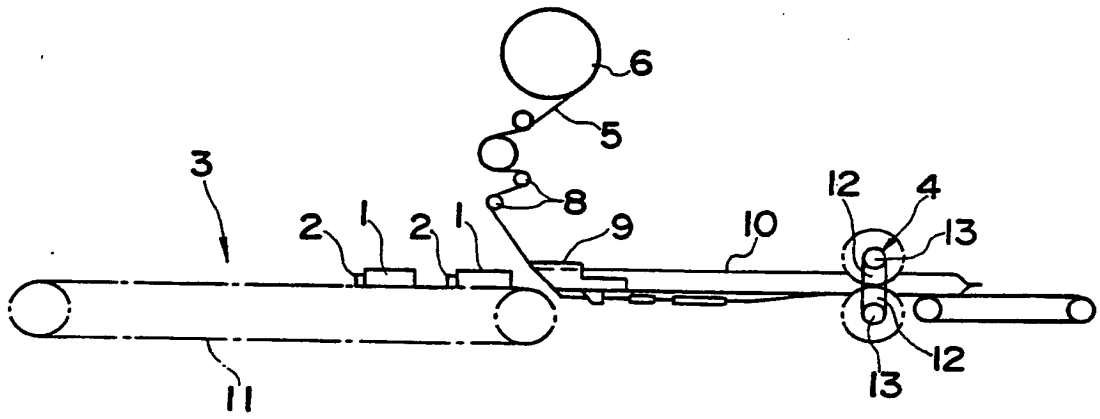

FIG. 2

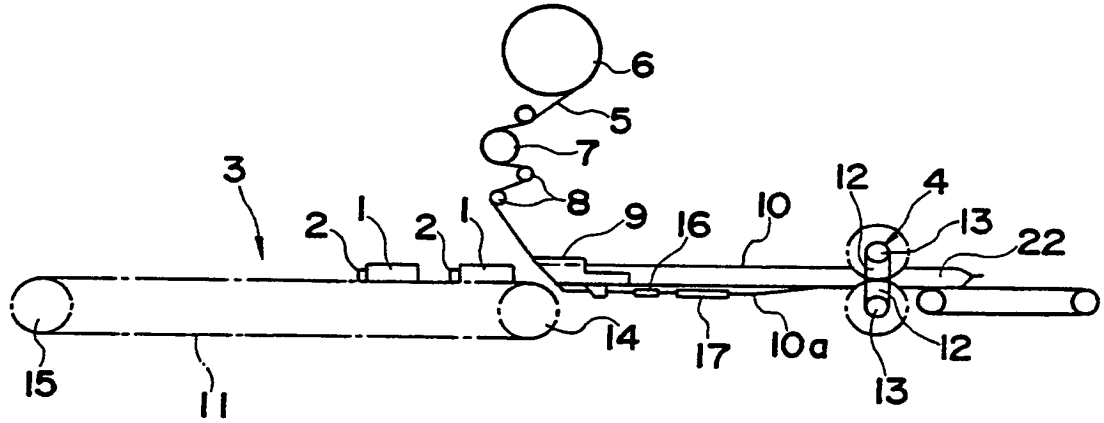

FIG. 3

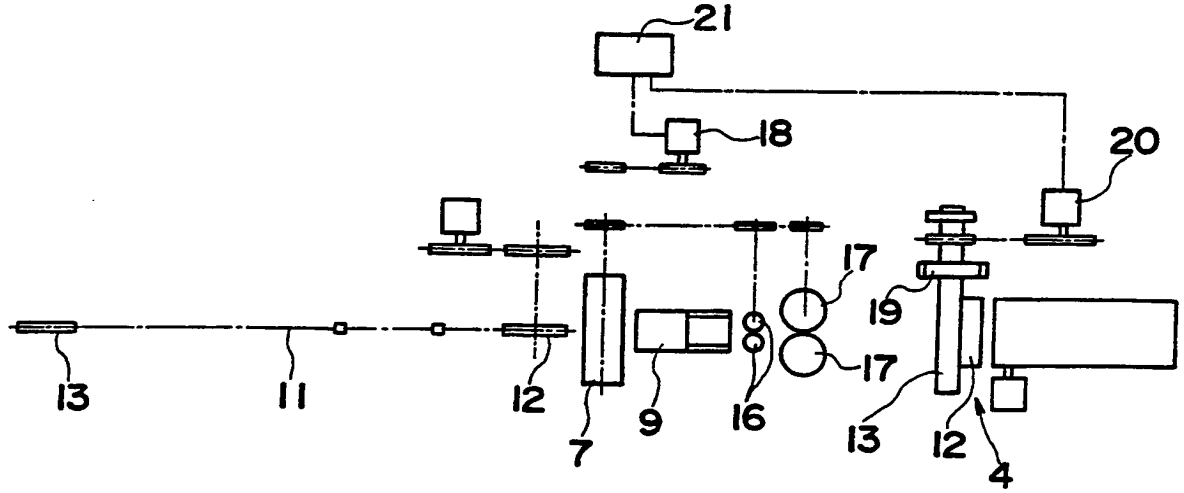

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FIG.4

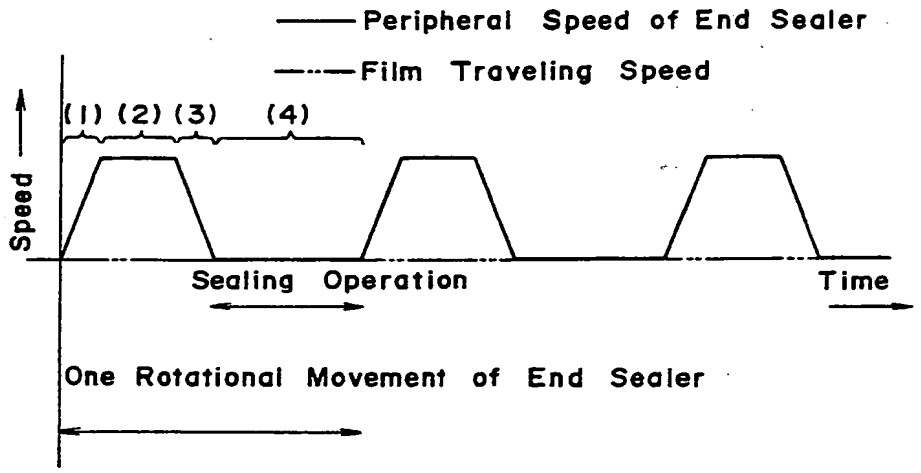

FIG.5

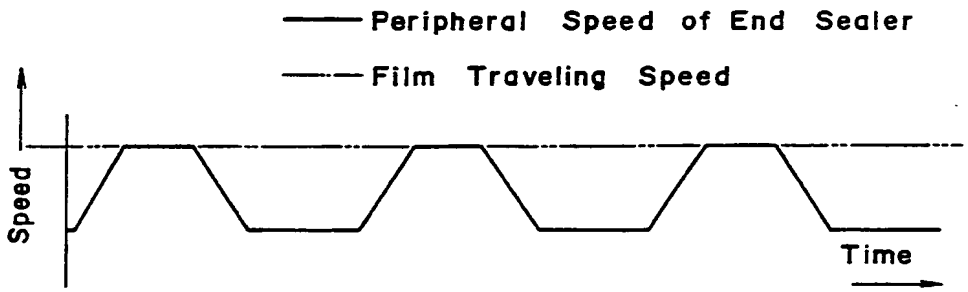

FIG.6

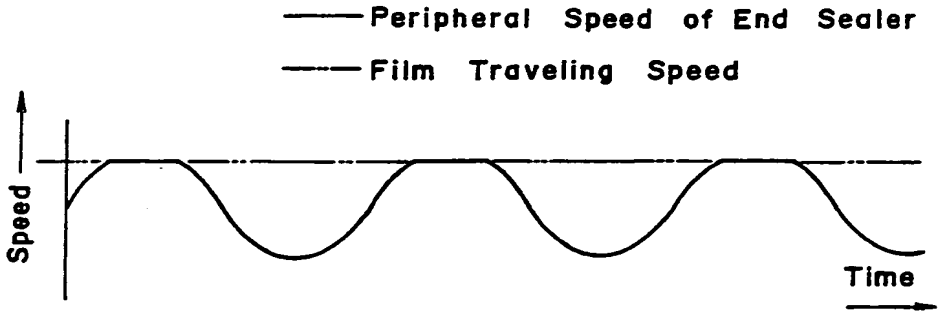

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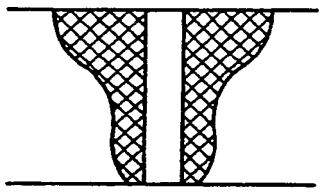
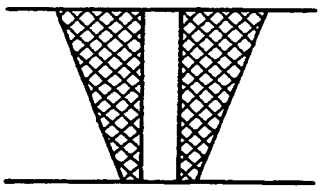
FIG. 7

(A)



(B)



AUTOMATIC SEALING METHOD

The present invention relates to an automatic sealing method and, more particularly, to improvement in or relating to a method for automatically sealing a continuous tubular film of a suitable plastic material at predetermined intervals in a transverse direction of its travel so as to form individual bags. The invention is particularly applicable to a packaging machine.

One of typical packaging machines is a horizontal pillow type as shown in Fig. 1 which is widely employed for automatic packaging of articles. This type automatic packaging machine comprises a conveying unit 3 equipped with flights 2 for conveying packaging articles 1 at predetermined intervals, a sealing unit 4 disposed downstream of the conveying unit 3, and a film supply reel 6 having wound thereon a band-shaped film 5 as of synthetic resin or a suitable plastic material. A plurality of film guide rollers 8 are disposed between the film supply reel 6 and the conveying unit 3, and a bag-making device 9 is disposed at a position adjacent the downstream end of the conveying unit 3. The film 5 wound on the supply reel 6 is drawn out therefrom and guided by the guide rollers 8 to the bag-making device 9, wherein it is formed into a continuous tube 10. The

conveying unit 3 includes an endless chain 11 to which the flights 2 are attached for movement therewith. Each article 1 is placed on the endless chain 11 with its rear end being in contact with the flight 2, so that the article 1 is forwarded from the left-hand side to the right-hand side in Fig. 1 as the endless chain 11 moves. At the downstream end of the conveying unit 3 the article 1 is received into the bag-making device 9 and is introduced into the film tube 10. Thereafter, the article 1 is carried by the film tube 10 to the sealing unit 4 which is adapted to cut and seal the film in the transverse direction at predetermined pitch, hereinafter referred to as cut-pitch.

The sealing unit 4 comprises a pair of end sealers 12-12 each secured at its one end to a rotary shaft 13. The other ends of sealers constitute sealing surfaces which engage with each other when the end sealers face each other, so that the sealing surfaces sandwich the film tube 10 to heat-seal the latter. The sealing surface is usually provided with a knife blade for cutting the sealed end of the film tube 10. The sealing unit 4 is arranged in such a manner that each end sealer 12 completes one rotation in a period of time during which the film tube 10 travels a distance equal to the cut-pitch. It is also known in the art to use end sealers of a so-called box motion type in which each end sealer moves along a predetermined locus in each cycle

and in which the end sealers engage with each other at a time interval during which the film tube 10 travels a distance equal to the cut-pitch.

The packaging machine of the type set forth above is designed for automatically packaging articles of various shapes and sizes, and the cut-pitch of the film tube varies according to the articles to be packed. Thus, it is unusual that the sealing surface of the end sealer moves the same distance as the cut-pitch in each rotation or cycle. A discrepancy between the moving distance and the cut-pitch is compensated by adjusting a rotational speed of the end sealer. This however renders the peripheral speed of the end sealer different from the traveling speed of the film tube. If the peripheral speed is lower than the traveling speed, the end sealers, when sandwiching the film tube, tend to slacken the latter and come into contact with the article in the film tube, causing an undesirable seal and displacement of the article relative to the film tube. On the other hand, when the peripheral speed is higher than the traveling speed, the end sealers pull the film tube and cause it to fluctuate, preventing the film tube to be sealed at exact portions.

One method that has been proposed to solve the above problems is to selectively increase and decrease the peripheral speed of the end sealers during one rotation or cycle. In this instance, taking into account a demand

for stable running of the machine, it has also been proposed to vary the peripheral speed of the end sealers in a sequential manner just like a sine wave so that in the vicinity of a maximum or minimum value the peripheral speed is substantially equalized to the film traveling speed. The sealing surfaces of end sealers, however, must be in contact with the film tube for a period of time sufficient to heat-seal it. In the above proposals, the peripheral speed of end sealers and the film traveling speed become equal to each other at only one time point (in the case where the highest (or lowest) speed of the former is selected to be equal to the speed of the latter) or at two time points at most during the period of contact; namely, the both speeds agree only in an instant. Accordingly, the above method is not a full solution to the afore-mentioned defect of the prior art.

It is therefore an object of a preferred embodiment of the present invention to provide an automatic sealing method which permits optimum sealing of a film tube regardless of a variation in a cut-pitch thereof.

According to the invention, in an automatic sealing method in which a continuous tubular film traveling at a substantially constant speed is sealed at predetermined pitch in a transverse direction of the travel by sealing means disposed across the path of the tubular film, the sealing means is moved at substantially the same speed as

the tubular film during at least a period in which the sealing means is in contact with the tubular film.

According to another aspect of the invention, an automatic sealing method comprises the steps of forwarding a continuous tubular film at a substantially constant speed, and sealing the tubular film at predetermined pitch in a transverse direction of the travel thereof by sealing means having two opposite sealing surfaces each adapted to move along a predetermined locus. The sealing surfaces cyclically engage with each other for sandwiching the tubular film therebetween to thereby seal it, and a distance of movement of the sealing surface in each cycle is different from the pitch at which the tubular film is to be sealed. The sealing surface moving speed is normally different from the film traveling speed to compensate the difference between the distance of movement of the sealing surface and the sealing pitch of the tubular film and is substantially equalized to the film traveling speed during a period of time in which the sealing surfaces engage each other.

The substantially equalized moving speed of the sealing means ensures a smooth and precise sealing of the tubular film without slackening or fluctuation of the latter.

Other objects, features and advantages of the invention will become apparent from the following

description of preferred embodiments when taken in conjunction with the accompanying drawings.

Fig. 1 is a schematic side view of a prior art packaging machine;

Fig. 2 is a side view schematically illustrating an example of a packaging machine to which the present invention is applied;

Fig. 3 is a plan view thereof;

Fig. 4 is a graph showing the relationship between a film traveling speed and a peripheral speed of end sealer;

Figs. 5 and 6 are graphs similar to Fig. 4 but showing modified speed variations of end sealer; and

Figs. 7A and B are diagrams schematically showing examples of a sealing surface of end sealer.

Figs. 2 and 3 illustrate, by way of example, a packaging machine to which a method of the present invention is applied. Since the machine of this embodiment is basically identical in construction with the above described conventional machine, the parts corresponding to those of the latter are identified by the same reference numerals.

As shown in Figs. 2 and 3, a sealing unit 4 is disposed ahead of a conveying unit 3 for conveying packaging articles 1 at predetermined intervals, and a

film supply reel 6 having wound thereon a band-shaped film 5 is disposed above the conveying unit 3. The film 5 wound on the supply reel 6 is drawn out therefrom by a drawing-out roller 7 and guided across a plurality of tension rollers 8 to a bag-making device 9 which is disposed adjacent the downstream end of the conveying unit 3. The film 5 thus guided to the bag-making device 9 is formed into a tube 10 which continues to travel to the sealing unit 4 as described hereinafter. The articles 1 fed by the conveying unit 3 are introduced into the device 9 where the film tube 10 receives the articles 1 to carry the same downstream.

The conveying unit 3 comprises a pair of sprockets 14 and 15 and an endless chain 11 extending between the sprockets. A plurality of flights 2 are attached to the endless chain 11 at predetermined intervals so that the articles 1 placed on the chain 11 may be forwarded from the left-hand to the right-hand in Fig. 2 with the flights 2 being in contact with the rear ends of the articles 1. A pitch of the flights 2 is selected sufficiently large in order to permit the articles of different sizes to be conveyed, and therefore the flight pitch is usually larger than the cut-pitch at which the film tube 10 is cut into individual packages by the sealing unit 4.

Provided adjacent the outlet of the bag-making device 9 are a pair of rollers 16-16 which abut against

each other to grip an overlapping longitudinal end 10a of the film tube 10 therebetween and to feed the film tube 10 forwardly by their rotational movement. A pair of center sealers 17-17 are disposed ahead of the rollers 16 for sealing the overlapping end 10a, the sealed end constituting a bottom center of the film tube 10. These rollers 16 and center sealers 17 are connected to and driven by a first drive motor 18 which also drives the drawing-out roller 7 via transmission means (not shown). Accordingly, the film traveling speed is determined by the running speed of the first motor 18.

The sealing unit 4 includes a pair of rotary shafts 13-13 disposed above and below a path of the film tube 10, respectively, and a pair of end sealers 12-12 each fixedly mounted at one end thereof on the rotary shaft 13. The other end of the end sealer 12 constitutes a sealing surface which is maintained at a temperature higher than a melting point of the film by means of a heater (not shown) incorporated in the end sealer 12. A knife blade (not shown) is provided on the sealing surface of the end sealer 12 so that the film tube 10 is cut transversely at the sealed portion to provide individual packages. The rotary shafts 13 have gears 19 (only one of which is shown in Fig. 3) which are attached thereto and mesh with each other for synchronous rotation of the two shafts. One of the rotary shafts 13 is coupled to a second drive motor 20 via transmission means

(not shown).

The first and second motors 18 and 20 are electrically connected to a control unit 21 which is adapted to control the running speeds of these motors. Specifically, under control of the unit 21, the first motor 18 for driving the drawing-out roller 9 etc. is driven at a substantially constant speed while speed of the second motor 20 for driving the sealing unit 4 is varied at such predetermined timing as depicted in Fig. 4. The control of the second motor 20 is such that the peripheral speed of the end sealer 12 becomes substantially equal to the traveling speed of the film tube 10 during a period in which the sealing surface of the end sealer 12 is in contact with the film tube 10 for the sealing operation, as more fully described hereunder.

Next, an embodiment of the method of the present invention will be described in connection with the above-described machine. The articles 1 supplied on the unit 3 are conveyed at predetermined intervals and pushed by the flights 2 into the film tube 10 one after another, thereafter being forwarded to the sealing unit 4 seals the film tube 10 along its transverse direction at portions between the adjacent articles 1 and cuts the sealed portions to provide individual packages 22. In order to seal and cut the film tube at regular intervals, a period of time during which the end sealer 12 completes one rotational movement should be equalized to a period

of time during which the film tube 10 travels a distance equal to the cut-pitch.

In accordance with the invention, as the first motor 18 is driven at the constant speed, the band-shaped film 5 as well as the film tube 10 travels also at the constant speed as seen from Fig. 4. Immediately after the sealing unit 4 completes the sealing and cutting operation of the film tube 10, the control unit 21 sends a signal to the second motor 20 to accelerate its running speed, and consequently the peripheral speed of the end sealers 12 increases (region (1)). The high-speed running (region (2)) for rotating the end sealers 12 at high speed continues until the sealing surfaces of end sealers approach the film tube 10, that is, until the upper end sealer 12 approaches its lowermost position and the lower end sealer 12 approaches its uppermost position, and then the second motor 20 is decelerated to slow down the peripheral speed of the end sealers 12 (region (3)). The high-speed region (regions (1) to (3)) is to compensate the difference between the cut-pitch of the film tube 10 and a distance of movement of the sealing surface in each rotation of the end sealer 12, and to seal the film tube 10 at a predetermined time interval during which the film tube 10 travels a distance equal to the cut-pitch. The time set for each of the regions (1) to (3) is determined by various factors including the cut-pitch of the film tube 10 and the

radius of rotation of the sealing surface, i.e. the length of the end sealer 12.

The deceleration region (3) is so set that the peripheral speed of the end sealers 12 becomes substantially equal to the film traveling speed when the forward ends of the sealing surfaces come into contact with each other through the film tube 10. This peripheral speed is maintained during a region (4) in which the sealing surfaces engage with each other and sandwich the film tube 10 therebetween to heat-seal it. Because the sealing surfaces move at the substantially same speed as the film during the sealing operation, the film tube 10 is kept stretched without fluctuation and can be sealed satisfactorily. Upon completion of each sealing operation, the end sealers 12 proceed again to the high-speed running in preparation for the next sealing operation.

While in the above embodiment the present invention has been described in connection with the case where the articles 1 are relatively small in size, that is, where the cut-pitch of the film tube 10 is shorter than the distance of movement of the sealing surfaces in each rotation of the end sealers 12, the invention is not limited specifically thereto and is also applicable to a case where the cut-pitch is longer than such distance. In that case, the running speed of the second motor 20, i.e. the peripheral speed of the end sealers 12, is

controlled in a manner illustrated in Fig. 5. Thus, the end sealers 12 are normally rotated at a speed lower than the film traveling speed and is accelerated to a speed equal to the film speed during the sealing operation.

In Figs. 4 and 5 the peripheral speed of end sealers 12 is changed linearly so that its waveform becomes substantially trapezoid, but it is also possible to vary the peripheral speed continuously except during the sealing operation as shown in Fig. 6. The waveform in Fig. 6 representing the speed variation is similar to a sine wave so smoothed at its crest that the peripheral speed is maintained equal to the film speed during the sealing operation.

The sealing surface of the end sealer 12 may be of any desired shape including those as shown in Figs. 7A and B for example. The term "transverse direction" used herein in connection with the seal of the film tube should not be interposed as constituting a right angle relative to the film traveling direction.

The control unit in the illustrated embodiment comprises a micro-computer, but various electrical means or mechanical means such as a cam may be employed for effecting the speed changes of the sealing unit.

The film need be fed at a substantially constant speed, which means that a slight variation in speed may be allowable as long as it does not involve fluctuation of the film which will cause the article to get out of

position in the film tube.

The sealing unit used in the above embodiment is the rotary type, and the present method may also be applied to a box motion type in order to control a moving speed of an end sealer in each cycle.

Further, application of the present invention is not limited to the pillow type packaging machine in which a sheet of the band-shaped film is formed into a tubular shape. The sealing method of the invention is also applicable to, for example, a three-sided or four-sided packaging machine in which two sheets of film are placed one on the other and sealed together at three or four sides, two of those sides extending transversely to the film traveling direction.

The invention is particularly suitable for use in a packaging machine in which articles are wrapped and simultaneously sealed in a bag, but it is also applicable to a bag making machine adapted to produce bags from a continuous film sheet.

As described above, the method of the invention permits the film to be sealed neatly and precisely at predetermined portions because the sealing unit is moved at the substantially same speed as the film when the sealing unit is in contact with the film.

Although the invention has been described with its preferred embodiments, it will be apparent that many modifications and variations may be effected without

departing from the scope of the novel concepts of the invention.

CLAIMS:

1. An automatic sealing method in which a continuous tubular film traveling at a substantially constant speed is sealed at predetermined pitch in a transverse direction of the travel by sealing means disposed across the path of said tubular film, wherein said sealing means is moved at substantially the same speed as said tubular film during at least a period in which said sealing means is in contact with said tubular film.

2. An automatic sealing method as claimed in claim 1, wherein said sealing means comprises a pair of end sealers each having a sealing surface adapted to move along a predetermined locus, said sealing surfaces cyclically engaging with each other for sandwiching said tubular film therebetween to thereby seal said tubular film.

3. An automatic sealing method as claimed in claim 2, wherein said sealing surface moves in each cycle a distance longer than the pitch at which said tubular film is to be sealed, and wherein the moving speed of said sealing surface is normally higher than the traveling speed of said tubular film and is reduced to substantially agree with the film traveling speed during the period in which said sealing surface is in contact with said tubular film.

4. An automatic sealing method as claimed in claim 2, wherein said sealing surface moves in each cycle a distance shorter than the pitch at which said tubular film is to be sealed, and wherein the moving speed of said sealing surface is normally lower than the traveling speed of said tubular film and is increased to substantially agree with the film traveling speed during the period in which said sealing surface is in contact with said tubular film.

5. An automatic sealing method comprising the steps of:

forwarding a continuous tubular film at a substantially constant speed; and

sealing said tubular film at predetermined pitch in a transverse direction of the travel thereof by sealing means having two opposite sealing surfaces each adapted to move along a predetermined locus, said sealing surfaces cyclically engaging with each other for sandwiching said tubular film therebetween to thereby seal it, and a distance of movement of said sealing surface in each cycle being different from the pitch at which said tubular film is to be sealed;

wherein said sealing surface moving speed is normally different from the film traveling speed to compensate the difference between the distance of movement of said sealing surface and the sealing pitch of said tubular film and is substantially equalized to the

film traveling speed during a period of time in which said sealing surfaces engage each other.

6. An automatic sealing method as claimed in claim 5, wherein the distance of movement of said sealing surface is longer than the sealing pitch of said tubular film, and wherein the sealing surface moving speed is normally higher than the film traveling speed and is reduced during the engaging period.

7. An automatic sealing method as claimed in claim 5, wherein the distance of movement of said sealing surface is shorter than the sealing pitch of said tubular film, and wherein the sealing surface moving speed is normally lower than the film traveling speed and is increased during the engaging period.

8. An automatic sealing method substantially as herein described with reference to Figures 2-7.